

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)	
)	
Expanding the Economic and Innovation)	Docket No. 12-268
Opportunities of Spectrum Through Incentive)	
Auctions)	

REPLY COMMENTS OF ALCATEL-LUCENT

Alcatel-Lucent submits these reply comments in response to the above-captioned Notice of Proposed Rulemaking (“NPRM”) seeking comment on moving forward with incentive auctions as authorized by the Middle Class Tax Relief and Job Creation Act of 2012 (the “Spectrum Act”).

Alcatel-Lucent is pleased to respond to the extensive record submitted in this proceeding. The initial comments overwhelmingly demonstrate substantial efforts by industry stakeholders to lay the foundation for a successful incentive auction. It is particularly encouraging that a broad cross-section of commenters has begun to build consensus around a number of key technical issues. Alcatel-Lucent strongly disagrees, however, with comments that advocate for guard bands¹ far larger than technically reasonable, and therefore contrary the mandates set forth in the Spectrum Act.

¹ Alcatel-Lucent interprets the term “guard band” as used in the Spectrum Act to include any portion of the new 600 MHz band plan not allocated to licensed TV broadcast services or licensed wireless services. The term guard band therefore includes those frequencies in a duplex gap separating wireless uplink and wireless downlink that do not include licensed services.

I. THERE IS WIDE AGREEMENT ON SEVERAL CORE TECHNICAL ISSUES

Alcatel-Lucent addresses a number of technical issues in its comments on which broad consensus is building, as discussed below. As an initial point of clarification, it has come to our attention that some have perceived our initial comments as an endorsement of the use of Time Division Duplexing (TDD) over Frequency Division Duplexing (FDD) in this band. Alcatel-Lucent clarifies that it has not endorsed either alternative, but rather describes in its comments the separate technical considerations of TDD and FDD band plans. Alcatel-Lucent will continue to review this issue and offer its technical expertise as this proceeding moves forward.

The technical analyses in the initial comments provide clear direction to the Commission on several key points. Specifically, there is broad agreement with the Commission's proposal that, for an FDD band plan, the returned 6 MHz TV Channels should be auctioned in 5 MHz blocks.² Similarly, with respect to TDD, which uses the same spectrum for uplink and downlink, 10 MHz TDD blocks would be appropriate building blocks.³

The record further favors a band plan that minimizes operation of TV Broadcast channels interspersed with wireless services, and raises technical concerns with the Commission's proposal to include TV broadcast operations in the gap between wireless uplink operations and Channel 37. This preference for avoiding interspersed TV broadcast and wireless

² See, e.g., Comments of Alcatel-Lucent at 24-25; Comments of Nokia Siemens Networks US LLC at 9 ("NSN Comments"); Comments of Qualcomm Inc. at note 12; Comments of T-Mobile at 14.

³ See Comments of Sprint Nextel Corporation at 22.

operations has been voiced by mobile operators,⁴ equipment vendors,⁵ the broadcast industry,⁶ as well as advocates for unlicensed spectrum.⁷

Those parties recommending an FDD band plan overwhelmingly favor a band plan similar to the Commission's "Down from Channel 51" alternative approach.⁸ There is also wide agreement that, in an FDD band plan, the Commission should maximize paired spectrum above Channel 37.⁹ A TDD band plan similarly should not include TV broadcast operations in guard bands or any type of "split" that would accommodate TV broadcast operations interspersed with wireless operations.¹⁰

With respect to an FDD band plan approach, there are several other areas of clear consensus. The record demonstrates that there need not be any guard band separating the lower 700 MHz band and upper 600 MHz uplink band.¹¹ The duplex gap should be 10 to 12 MHz wide, and need not be any wider.¹² Further, the guard bands between wireless operations and

⁴ Comments of AT&T Inc. at 24-26; Comments of T-Mobile USA Inc. at 8, 10; Comments of Verizon and Verizon Wireless at 18 ("Verizon Comments").

⁵ Comments of Alcatel-Lucent at 14-16; NSN Comments at 11; Comments of Motorola Mobility LLC at 9-10; Comments of Qualcomm at 4-5 & note 28.

⁶ Comments of the National Association of Broadcasters at 33-39.

⁷ Comments of Google Inc. and Microsoft Corporation at 32-34 ("Google/Microsoft Comments").

⁸ NPRM at ¶ 78, Figure 12; Comments of Alcatel-Lucent at Figure 2; Comments of AT&T Inc. at Figure 4; Google/Microsoft Comments at 32; Comments of Motorola Mobility LLC at 9-10; Comments of Qualcomm Inc. at 4; Comments of T-Mobile USA Inc. at Figure 1; Verizon Comments at Figure 1.

⁹ See Comments of Alcatel-Lucent at 13; Comments of AT&T Inc. at Figure 4; Verizon Comments at 14.

¹⁰ See Comments of Sprint Nextel Corporation at 22.

¹¹ NPRM at ¶ 135; Comments of Alcatel-Lucent at 21; Verizon Comments at 14.

¹² See, e.g., Comments of Alcatel-Lucent at 21-22; Comments of AT&T Inc. at 34 (AT&T's advocacy for a potentially larger gap, i.e. 14 MHz, applies primarily if the duplex gap includes

broadcast services should be approximately 10 MHz wide¹³ (although slightly smaller may also be adequate).¹⁴ For any unlicensed uses permitted in the guard bands, the Commission should adopt appropriately low power limits and controls on out-of-band-emissions to ensure licensed services are protected,¹⁵ as expressly required by the Spectrum Act.¹⁶

These areas of consensus are fully consistent with the illustrative band plan advocated by Alcatel-Lucent.¹⁷ While there may be some variation around the edges at this time, Alcatel-Lucent is confident that, as this proceeding continues, all stakeholders – and particularly those stakeholders that are likely to participate in the reverse and forward auctions – will continue to work toward greater and more-refined consensus to best execute a successful incentive auction.

II. ANY DUPLEX GAP SIGNIFICANTLY LARGER THAN 10 MHZ WOULD BE UNREASONABLE AND UNLAWFUL

As noted above, an FDD band plan will require a duplex gap separating uplink and downlink operations. The record overwhelmingly favors a duplex gap of 10 to 12 MHz in

two supplemental wireless downlink blocks); Comments of T-Mobile USA, Inc. at 10; Verizon Comments at 18-19; NSN Comments at 9.

¹³ See Alcatel-Lucent at 22-24; Comments of Motorola Mobility LLC at 9-10; Verizon Comments at 19-20.

¹⁴ Alcatel-Lucent at 22-24.

¹⁵ Comments of AT&T Inc. at 22-23; see Comments of the National Association of Broadcasters at 48 (“The basic premise of all Part 15 unlicensed operation is the protection of licensed services”); NSN Comments at 19 (unlicensed operations must “not impede the maximization of licensed spectrum or compromise the licensed uses in terms of potential harmful interference”); Comments of Qualcomm Inc. at 22-23 (voicing concerns that any unlicensed operations in the guard bands may be problematic).

¹⁶ Spectrum Act, § 6407(d) (“The Commission may not permit any use of a guard band that the Commission determines would cause harmful interference to licensed services”).

¹⁷ Comments of Alcatel-Lucent at Figure 2.

the 600 MHz band,¹⁸ including companies that are likely to participate in the forward auction and operate licensed services in the band. In contrast, the suggestion made by Google and Microsoft in their joint comments that wireless services will require a 28 MHz duplex gap,¹⁹ or anything close to that, is technically inaccurate, and any attempts to inflate duplex gap size to benefit unlicensed spectrum are contrary to the plain language of the Spectrum Act.

As Alcatel-Lucent explains in its initial comments, the key metric for determining the appropriate size of the duplex gap is based on a fixed fraction of the center frequency of the duplex gap.²⁰ Using today's commercially available technology, filters with duplex gaps of 1.5% or more of the center frequency are entirely reasonable. Thus, in a "Down from Channel 51" band plan starting with 25 MHz of uplink, a 10.0 MHz duplex gap (e.g., 1.5% of 668 MHz) would be appropriate. Alcatel-Lucent's comments also offer a small variation of that band plan that includes 30 MHz of uplink down from Channel 51, changing the center frequency to 663 MHz. In that case, 10 MHz would be achievable with even greater ease. In either case, a slightly larger duplex gap such as 12 MHz would still be reasonable, and would likely make user equipment ("UE") filter design easier to implement with less insertion loss, size, weight, cost, and waveform quality degradation. Larger than 12 MHz, however, would be excessive.

Examples drawn from higher frequency bands are distinguishable from the 600 MHz band. Specifically, one should not mistake the width of the total band of operation (e.g., 25 or 30 MHz) for the carrier bandwidth for a single UE device (a subset of the total pass band).²¹

¹⁸ See *supra* note 12.

¹⁹ Google/Microsoft Comments at 37.

²⁰ Comments of Alcatel-Lucent at 21.

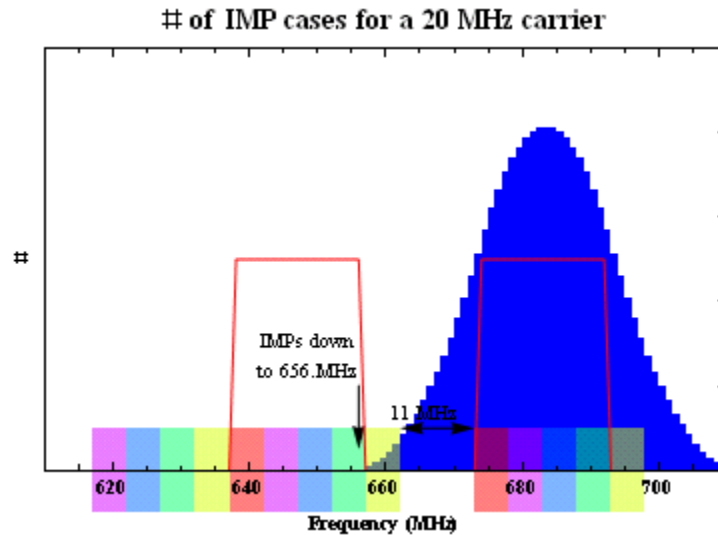
²¹ See Google/Microsoft Comments at Appendix, ¶ 15.

Looking at the specific examples Google and Microsoft cite in their joint comments,²² Alcatel-Lucent agrees that a 10 MHz gap in 3GPP Band 8 is too small (at 1.1% fractional bandwidth) falling well below the 1.5% minimum guidance of the 920 MHz center frequency in that band – but that is irrelevant to the appropriate duplex gap at 600 MHz where 10 MHz corresponds to 1.5%. On the other side of the scale, Alcatel-Lucent agrees that the 28 MHz duplex gap in 3GPP Band 11 (i.e., 1427.9-1447.9 MHz for uplink and 1475.9-1495.9 MHz for downlink) may be slightly larger than necessary, but is within the bounds of reasonable *for that band*. In Band 11, the 28 MHz gap represents a frequency ratio of approximately 1.9% (using 1461.9 as the center frequency). In the 600 MHz band, that would be consistent with our suggested 12 MHz duplex gap as reasonable (approximately 1.8% of the center frequency). In contrast, if a 28 MHz duplex gap were applied to the 600 MHz band, the ratio would be about 4.3%, roughly two to three times what would be recommended.

Google's and Microsoft's stated concerns that intermodulation interference requires a 28 MHz duplex gap also lack merit.²³ We have investigated whether a 600 MHz UE's transmitter 3rd order Intermodulation Products (IMP) or UE antenna path 3rd order passive IMP may fall into its own UE receive in-band and cause receiver desensitization, as Google and Microsoft claim. The illustration below, depicts an analysis of a worst-case 20 MHz carrier in a 25 MHz band, and shows that the 3rd order IMP are all above the corresponding downlink blocks, so will not cause any self-interference.

²² Google/Microsoft Comments at 37.

²³ *Id.* at 38-39.



The 656 MHz IMP extent shown here does not extend into the 18 MHz occupied band.

For scenarios of 5, 10 or 15 MHz carriers, this engineering analysis finds that a 10 MHz duplex gap is sufficient to prevent the LTE UE transmitter/receiver 3rd order IMP or antenna path passive IMP from falling into its own UE Rx in-band. The carrier block position does not affect this calculation. To that end, Alcatel-Lucent included in its review 5, 10 and 15 MHz channels, as well as the unlikely case of a single operator winning a 20 MHz contiguous FDD block at auction. Only at 20 MHz channels, with all 18 MHz active resource blocks within the 20 MHz LTE channel assigned to a UE, does a 10 MHz duplex gap (located at 663-673 MHz) appear to be insufficient. Under those unlikely conditions, the 20 MHz LTE UE transmitter/receiver 3rd order IMP or antenna path 3rd order passive IMP will fall into 656-710 MHz which could cover the upper 1 MHz of its own UE Rx resource blocks at 639-657 MHz. This is at a weak tail of the IMP spectrum and only overlaps 5% of its band, so it may be acceptable. Even then, however, a duplex gap of 11 MHz would prevent the LTE UE 3rd order IMP or passive IMP from falling into its own UE Rx resource blocks – far short of the 28 MHz duplex gap proposed by Google and Microsoft. Higher order IMPs are weaker still and have not been seen to be problems in other bands.

Having demonstrated that the technical underpinnings of anything even approaching a 28 MHz duplex gap lack merit, it follows that a statutory analysis attempting to justify such a large duplex gap would be similarly infirm. Alcatel-Lucent is a major proponent of innovative spectrum frameworks, including spectrum sharing and unlicensed uses.²⁴ However, the Spectrum Act clearly directs the Commission to favor licensed spectrum over unlicensed spectrum in the 600 MHz band. Far from making “robust unlicensed operations”²⁵ a priority facilitated through a large duplex gap, the Spectrum Act does not mandate the existence of *any* guard bands or unlicensed use in those guard bands in the 600 MHz band.²⁶ Indeed, the Spectrum Act is so expressly focused on auctioning and licensing all spectrum reclaimed through the reverse auction and repacking processes, that the drafters found it necessary to clarify that the Spectrum Act does not “prevent” the Commission from implementing guard bands.²⁷

If the Commission determines in its discretion to include any guard bands in the 600 MHz band plan, the Spectrum Act directs that the Commission “*may* permit” unlicensed uses only in those guard bands.²⁸ With respect to the size of guard bands, the Commission’s discretion is limited. The Spectrum Act states that “Such guard bands shall be no larger than is

²⁴ See, e.g., Sen, T. Zhang, M. Buddhikot, S. Banerjee, D. Samardzija, S. Walker, A Dual Technology Femto Cell Architecture for Robust Communication using Whitespaces (Best Paper Award), Proceedings of IEEE DySPAN 2012, Seattle, Oct 16-19, 2012, Accessed Mar. 5, 2013 at <http://www.bell-labs.com/user/mbuddhikot/psdocs/DySPAN12-Whitecells-2012.pdf>.

²⁵ Google/Microsoft Comments at 37.

²⁶ Comcast and NBC Universal similarly err by seeking a 20 MHz duplex gap focused primarily on what it asserts best facilitates unlicensed WiFi use. Comments of Comcast Corporation and NBCUniversal Media, LLC at 40-47. To the contrary, as described herein, the sole measure that the Spectrum Act directs the Commission to use to determine guard band size is interference between *licensed* services.

²⁷ Spectrum Act, § 6407(a).

²⁸ *Id.* §§ 6403(a), 6403(c) (directing that returned spectrum is to be auctioned and licensed); *id.* § 6407 (providing the Commission limited authority to implement guard bands and allow unlicensed operations in the guard bands).

technically reasonable to prevent harmful interference between *licensed services* outside the guard bands.”²⁹ Furthermore, pursuant to the Spectrum Act, the Commission “may not permit any use of a guard band that the Commission determines would cause harmful interference to *licensed services*.”³⁰

Taken as a whole, the Spectrum Act prohibits the Commission from promoting unlicensed spectrum at the expense of licensed/auctioned spectrum. Again, guard bands must be “no larger than technically reasonable” in order to protect *licensed services* – the words “no larger than” placing a limit on the Commission’s discretion as to what it may determine is “technically reasonable.” In the 600 MHz band, as described above, a 10 MHz duplex gap is technically reasonable. Proponents of an extravagant duplex gap might argue that Alcatel-Lucent’s 10 MHz duplex gap recommendation is based on what is “necessary” not “reasonable.”³¹ Assuming for the sake of argument that is true, Alcatel-Lucent respectfully suggests that 11 or 12 MHz is a prime example of larger-than necessary, but still within the bounds of reasonable. However, it strains credulity to argue that the Spectrum Act authorizes the Commission to set guard bands of 2 to 3 times larger than the necessary size to protect licensed service, for the purpose of accommodating unlicensed uses.

Therefore, a duplex gap of 10 to 12 MHz would be considered technically reasonable and any proposal for a significantly larger duplex gap should be rejected as contrary to technical engineering analysis and statutory mandates under the Spectrum Act.

²⁹ *Id.* § 6407(b) (emphasis added).

³⁰ *Id.* § 6407(e) (emphasis added).

³¹ For example, Google and Microsoft argue that the Spectrum Act’s direction to implement “technically reasonable” guard bands provides the Commission greater discretion than would authority to implement “technically necessary” guard bands. Google/Microsoft Comments at 35-36.

III. CONCLUSION

Alcatel-Lucent urges the Commission adopt the foregoing proposals in its implementation of incentive auctions and the new 600 MHz wireless band plan and service rules.

Respectfully submitted,

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/s/

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